GAS-FILLED SURGE ARRESTER WITH ELECTRODE TERMINALS IN THE FORM OF BAND-LIKE CLIPS

The invention is in the field of over-voltage protection for communication networks and is concerned with the structural design of the power feed elements to the electrodes of a gas-filled surge arrester.

For protection against over-voltages as can occur, among other things, due to lightning strikes, gas-filled surge arresters are employed in communication networks and the appertaining devices that comprise one or two or, respectively, three discharge paths and, for this purpose, are composed of two end electrodes and, potentially, of a further electrode in the form of a middle electrode as well as of one or two hollow-cylindrical ceramic insulators.

Given two-electrode surge arresters, the ceramic insulator usually has its end face soldered to the end electrodes (US 4,266,260 A); given three-electrode surge arresters, the ceramic insulators are soldered either at their circumference at end face both to the middle electrode as well as to a respective end electrode (US 3,885,203 A, US 4,212,047 A). The contacting of the electrodes at their outer circumference thereby ensues either within a housing with the assistance of resilient clamps or with the assistance of leads that have their one end soldered or welded tangentially, radially or axially to a respective electrode and that have their other end provided with a pluggable contact element or fashioned for a soldering (US 4,212,047, US 4,984,125 A). In order to fashion the power feed elements in gas-filled surge arresters of the higher performance category such that they are also sure to withstand extreme current loads, it is also known to employ power feed elements in the form of a band-like clip that are fixed to the circumference of the surge arrester with a releasable clamp closure. A riveting or an ultrasound welding also come into consideration as non-releasable clamp closure. Further, the band-like clips can be fashioned so broad that they embrace not only the electrically conductive foot region of the respective end electrode but also the adjoining ceramic insulator over a respective part of its axial length. As a result thereof, the electrical behavior of the surge arrester can be positively influenced (DE 196 41 385 A1/US 5,768,082 A).

It is also known to arrange further component parts at the face end of the end electrodes of three-electrode arresters in order to realize short-circuit device (fail safe mechanisms) and/or in order to connect auxiliary discharge paths electrically parallel to the gas discharge paths. For radial fixing of the component parts, specific designs in the foot region of the end electrodes and a cap that resides under the influence of a spring and is electrically connected to the middle electrode of the surge arrester are employed (US 5,388,023 A, US 5,633,777 A, US 4,984,125 A/Figure 1a) are employed.

Proceeding from a gas-filled surge arrester having the features of the preamble of patent claim 1, the invention is based on the object of simplifying the mountability of the band-like clips and to thereby expand their function as far as possible.

For achieving this object, it is first provided that each clip allocated to an end electrode is resiliently fashioned in circumferential direction. This can be realized, for example, in that clip is provided by means of [sic] a two-leg, clamp-like batter. The clip can also be lent the form of a cap that comprises a hollow-cylindrical edge region and a planar cover region provided with a center opening, whereby the edge region has its circumference provided with a plurality of bead-like impressed portions that lie against the foot part of the respective end electrode. Given such a design of the clip, the electrical terminal of the respective end electrode can be prefabricated in the framework of an automatic manufacturing sequence and can also be slipped onto the respective end electrode. The spring tension of the clip thereby suffices in order to assure a reliable contacting of the respective end electrode given normal and medium current load.

A clip fashioned according to the invention can also exercise other functions when it is utilized for contacting given three-electrode arresters and is fashioned broad enough. In this case, the clip can be put in place such on the surge arrester that is projects axially beyond the foot part of the respective end electrode by a certain length. Parts of a short-circuit device electrically connected to the middle electrode can be allocated to this projecting region of the clip, as can, additionally, parts of an auxiliary discharge path connected electrically parallel to the gas discharge path, as warranted. To this end, a fusion disk and a spacer are arranged within the projecting

region of the clip; given a clip with a clamp-like batter, a disk-shaped auxiliary electrode can also be allocated to the clip, the diameter thereof being at least equal to the outside diameter of the clip, and said auxiliary electrode being held spaced from the edge of the clip by the fusion disk and the spacer and being pressed against the spacer by a spring. This spring can be a matter of a known spring clip (US 4,984,125, Figure 1). However, a coil spring or a spring washer can also be employed, this being fixed by a U-shaped shackle secured to the middle electrode. In a known way, the spacer holding the disk-shaped auxiliary electrode spaced from the edge of the clip can be an insulating member or -- preferably -- a varistor (see US 5,388,023, Figure 1).

Instead of a disk-shaped auxiliary electrode, a cap-like auxiliary electrode (similar to United States Letters Patent 5,633,777, Figure 3, part and United States Letters Patent 5,388,023, Figure 1, part 15) can also be provided, this being under the influence of a spring clip electrically connected to the middle electrode and having its edge projecting into the projecting region of the clip, accepting the fusion disk and the spacer, and being held insulated and spaced from the clip by a ring-like insulator part.

In the case of a clip in the form of a cap, the short-circuit device is formed by the planar cover surface of the cap and by that end of a spring clip connected to the center electrode that is free and engages into the center opening of the cap, whereby the short-circuit device is formed by the planar cover surface of the cap and by that end of a spring clip connected to the center electrode that is free and engages into the center opening of the cap, whereby the free end of the spring clip is held spaced from the planar cover surface of the cap by means of a fusion disk and the auxiliary discharge path that are arranged within the cap, and the fusion disk or the auxiliary discharge path is insulated from the planar cover surface of the cap by means of an insulating centering member. [sic!] Here, too, the auxiliary discharge path is composed of a varistor that is arranged insulated by means of the insulating centering member. However, a perforated mica folium can also serve as auxiliary discharge path, the fusion disk lying thereagainst insulated from the cap.

A number of exemplary embodiments of surge arresters fashioned according to the invention are shown in Figures 1 through 8. Thereby shown are:

Figure 1 a three-electrode arrester with a first embodiment of clip allocated to the end electrodes;

Figure 2 a two-electrode arrester with a first embodiment of clip allocated to the two electrodes;

Figure 3 a partial view of a three-electrode arrester having clips according to Figure 1 and with the short-circuit device allocated to an end electrode, said short-circuit device being combined with an auxiliary discharge path;

Figure 4 a modification of Figure 3 with an auxiliary electrode fashioned as cap;

Figure 5 a modification of Figure 3 with rigid retainer shackle for the short-circuit device and a spring washer allocated to the auxiliary electrode.

Also shown are:

Figure 6 a two-electrode arrester with a second embodiment of a clip to be allocated thereto;

Figure 7 a three-electrode arrester with clips in the form of a cap allocated to the end electrodes; and

Figure 8 a partial view of a three-electrode arrester with clips according to Figure 7 and with the short-circuit device allocated to an end electrode, said short-circuit device being combined with an auxiliary discharge path.

Figure 1 shows a schematic illustration of a three-electrode arrester 1 that comprises the two ceramic insulators 11 and 12 at both sides of a middle electrode 13 and on whose one end electrode (not shown) an electrical terminal in the form of a tightly fitting clip 2 is put in place. An identical clip 2 is shown next to the end electrode 14. This clip, which is composed of an annular metal band 21 whose ends are soldered or welded to form a terminal 22, has its circumference provided with a two-legged, clamp-like batter 23 lying approximately opposite the terminal 22, as a result whereof the clip 2 is rendered resilient in circumferential direction. The clip can be slipped onto the flange-like foot part 15 of the end electrode 14, whereby the dimensions of the foot part 15 of the end electrode 14 and of the clip 2 are selected such that an adequate contact pressure is established. In particular, the diameter of the

foot part 15 should be slightly larger than the diameter of the ceramic insulator 11 or, respectively, 12.

Figure 2 shows a two-electrode arrester that comprises a ceramic insulator 31, a first end electrode 33 as well as a second end electrode (not shown in detail), whereby a resiliently fashioned clip 2 is put in place on each end electrode.

Figure 3 shows portions of a three-electrode arrester according to Figure 1 that is augmented by a short-circuit device and combined with auxiliary discharge paths. In this case, the width b of the clip 24 put in place onto the end electrode 14 is selected so large that the clip not only embraces a part of the surface of the ceramic insulator 12 but also projects axially beyond the end electrode 14. As a result thereof, a cylindrical space is formed in which a disk 4 of a fusible material and a spacer 5 in the form of a varistor are arranged, whereby the spacer 5 is arranged centered within the clip 24 by means of a rubber-like ring 6. The assembly composed of fusion disk 4 and varistor 5 also has a centrally perforated auxiliary electrode 7 allocated to it that lies against the spacer/varistor 5 and is held by the free end of a spring clip 8 fixed to the middle electrode 13. The fusion disk 4 melts in case of overload, whereupon the auxiliary electrode 7 contacts the edge of the clip 24.

Figure 4 shows a modification of Figure 3, whereby the critical difference is comprised therein that a cap-shaped auxiliary electrode 84 is provided instead of a disk-shaped auxiliary electrode, a fusion disk 41 and a spacer/varistor 5 being arranged in said auxiliary electrode 84 and the edge 85 thereof residing opposite the foot part 15 of the end electrode within the projecting region of the clip 24. The auxiliary electrode 84 is arranged centered by an insulating ring 10 and is held spaced and insulated from the clip 24.

Figure 5 shows another modification of Figure 3, whereby the critical difference is comprised therein that the contact to the middle electrode 13 is produced via a non-resilient, U-shaped shackle 82 that presses a spring washer 83 against the auxiliary electrode 71. The spring washer -- shown in its relaxed condition to the right of the arrester -- lies against the disk-shaped auxiliary electrode 71 that has both sides provided with centering surfaces 72 or, respectively, 73 for the centered

allocation of the spring washer 83 and for the centered allocation of the spacer/varistor 5 within the projecting region of the clip 24.

Figure 6 shows a two-electrode arrester 3 with ceramic insulator 31 and end electrodes 33 and 34, whereby a clip 25 in the form of a cap with a hollow-cylindrical edge region 26 and a planar cover region 27 provided with a center opening 28 is to be allocated to each end electrode. The cap 25 is also implemented with a power terminal 29. Further, the cap has the circumference of the edge region 26 provided with a plurality of point-like or bead-like impressions 30 that, when the cap 25 is slipped onto an end electrode, result therein that the cap resiliently presses at the foot region of the respective end electrode and contacts this.

Figure 7 shows a three-electrode arrester 1 on whose end electrodes a respective cap 25 is put in place. According to Figure 8 and given a three-electrode arrester according to Figure 7, the cap can likewise be part of a short-circuit device connected to the middle electrode 13 and can potentially additionally be part of an auxiliary discharge path connected electrically parallel to the gas discharge path of the arrester. A cap 25 having adequate height h in order to be able to arrange a fusion disk 4 and a spacer 5 within the cap is employed for this purpose, whereby the spacer in the form of a varistor is arranged upon employment of an insulating centering member 9 in order to suppress a short-circuit between the free end 84 of the spring clip 8 and the cap 25 in the normal operating condition.